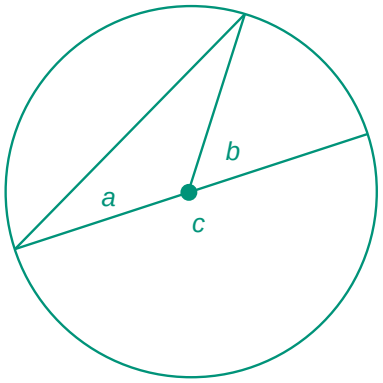
Geometry Mathematics Content Standards

The geometry skills and concepts developed in this discipline are useful to all students. Aside from learning these skills and concepts, students will develop their ability to construct formal, logical arguments and proofs in geometric settings and problems.

1.0 Students demonstrate understanding by identifying and giving examples of undefined terms, axioms, theorems, and inductive and deductive reasoning.

2.0 Students write geometric proofs, including proofs by contradiction.
If a line *L* is tangent to a circle at a point *P,* prove that the radius passing through *P* is perpendicular to *L*.

If *C* is the center of the circle in the figure shown below, prove that angle *b* has twice the measure of angle *a*.



3.0 Students construct and judge the validity of a logical argument and give counterexamples to disprove a statement.

Prove or disprove: If two triangles have two pairs of congruent sides, the triangles must be congruent.

4.0 Students prove basic theorems involving congruence and similarity.

Prove that in a triangle, the larger angle faces the longer side.

If L_1, L_2, and L_3 are three parallel lines such that the distance from L_1 to L_2 is equal to the distance from L_2 to L_3, and if l is any transversal that intersects L_1, L_2, and L_3 at A_1, A_2, and A_3, respectively, prove that the segments $A_1 A_2$ and $A_2 A_3$ are congruent.

Note: The sample problems illustrate the standards and are written to help clarify them. Some problems are written in a form that can be used directly with students; others will need to be modified before they are used with students.

Geometry

5.0 Students prove that triangles are congruent or similar, and they are able to use the concept of corresponding parts of congruent triangles.

Prove that a quadrilateral that has two pairs of congruent opposite angles is a parallelogram.

Prove that in $\triangle ABC$, if D is the midpoint of side AB and a line passing through D and parallel to BC intersects side AC at E, then E is the midpoint of side AC.

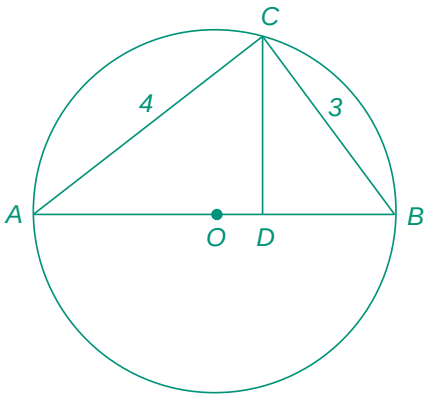
6.0 Students know and are able to use the triangle inequality theorem.

7.0 Students prove and use theorems involving the properties of parallel lines cut by a transversal, the properties of quadrilaterals, and the properties of circles.

Prove that the figure formed by joining, in order, the midpoints of the sides of a quadrilateral is a parallelogram.

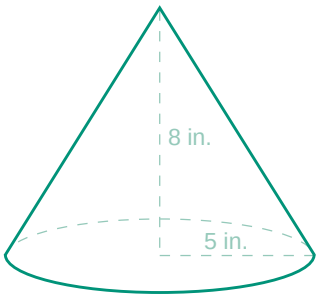
Using what you know about parallel lines cut by a transversal, show that the sum of the angles in a triangle is the same as the angle in a straight line, 180 degrees.

AB is a diameter of a circle centered at O. $CD \perp AB$. If the length of AB is 5, find the length of side CD.



8.0 Students know, derive, and solve problems involving the perimeter, circumference, area, volume, lateral area, and surface area of common geometric figures.

A right circular cone has radius 5 inches and height 8 inches.



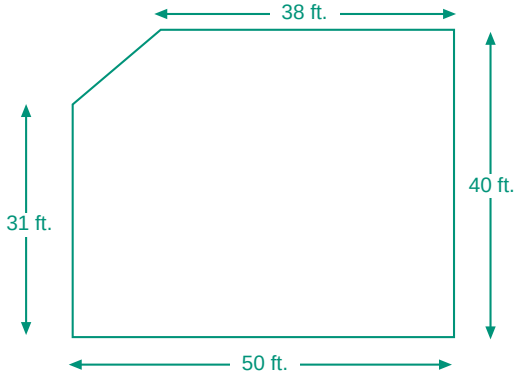
What is the lateral area of the cone? (Lateral area of cone = πrl, where l = slant height.) (CST released test question, 2004)

9.0 Students compute the volumes and surface areas of prisms, pyramids, cylinders, cones, and spheres; and students commit to memory the formulas for prisms, pyramids, and cylinders.

10.0 Students compute areas of polygons, including rectangles, scalene triangles, equilateral triangles, rhombi, parallelograms, and trapezoids.

Geometry

The diagram below shows the overall floor plan for a house. It has right angles at three corners. What is the area of the house? What is the perimeter of the house? (CERT 1997, 26)



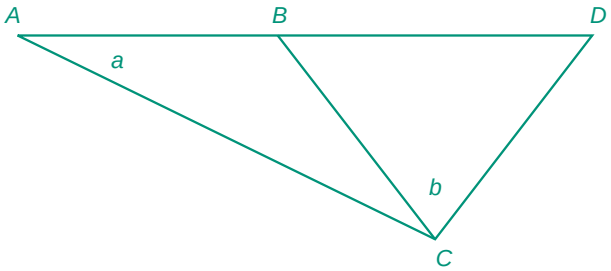
11.0 Students determine how changes in dimensions affect the perimeter, area, and volume of common geometric figures and solids.

A triangle has sides of lengths *a, b,* and *c* and an area *A.* What is the area of a triangle with sides of lengths 3*a*, 3*b*, and 3*c*, respectively? Prove that your answer is correct.

12.0 Students find and use measures of sides and of interior and exterior angles of triangles and polygons to classify figures and solve problems.

13.0 Students prove relationships between angles in polygons by using properties of complementary, supplementary, vertical, and exterior angles.

In the figure below, $\overline{AB} = \overline{BC} = \overline{CD}$. Find an expression for the measure of angle *b* in terms of the measure of angle *a* and prove that your expression is correct.



Geometry

14.0 Students prove the Pythagorean theorem.

15.0 Students use the Pythagorean theorem to determine distance and find missing lengths of sides of right triangles.

16.0 Students perform basic constructions with a straightedge and compass, such as angle bisectors, perpendicular bisectors, and the line parallel to a given line through a point off the line.

Prove that the standard construction of the perpendicular from a point to a line not containing the point is correct.

17.0 Students prove theorems by using coordinate geometry, including the midpoint of a line segment, the distance formula, and various forms of equations of lines and circles.

Use coordinates to prove that if *ABC* is a triangle and *D, E* are points on sides *AB* and *AC,* respectively, so that

$$\frac{|AD|}{|AB|} = \frac{|AE|}{|AC|},$$

then line *DE* is parallel to *BC.*

18.0 Students know the definitions of the basic trigonometric functions defined by the angles of a right triangle. They also know and are able to use elementary relationships between them. For example, $\tan(x) = \sin(x)/\cos(x)$, $(\sin(x))^2 + (\cos(x))^2 = 1$.

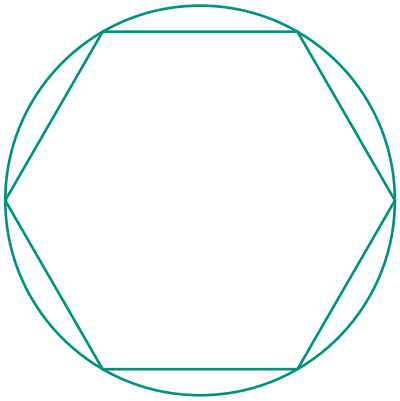
Without using a calculator, determine which is larger, tan(60°) or tan(70°) and explain why.

19.0 Students use trigonometric functions to solve for an unknown length of a side of a right triangle, given an angle and a length of a side.

20.0 Students know and are able to use angle and side relationships in problems with special right triangles, such as 30°, 60°, and 90° triangles and 45°, 45°, and 90° triangles.

21.0 Students prove and solve problems regarding relationships among chords, secants, tangents, inscribed angles, and inscribed and circumscribed polygons of circles.

Use the perimeter of a regular hexagon inscribed in a circle to explain why $\pi > 3$. (ICAS 1997,11)[4]



22.0 Students know the effect of rigid motions on figures in the coordinate plane and space, including rotations, translations, and reflections.

Use rigid motions to prove the side-angle-side criterion of triangle congruence.

[4] The Web site showing the source for the problems from the Intersegmental Committee of the Academic Senates (ICAS) is in the "Web Resources" section in "Works Cited."